

**NEW SCIENCE PROSPECTS WITH  
100-DAY BALLOONING**



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**STRATOSPHERIC OBSERVATORY  
FOR  
ASTRONOMICAL RESEARCH  
(SOAR)**

Giovanni G. Fazio  
Gary J. Melnick  
Smithsonian Astrophysical Observatory  
Cambridge, MA 02138

# STRATOSPHERIC OBSERVATORY FOR ASTRONOMICAL RESEARCH (SOAR)



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- THE SOAR MISSION

- » SOAR is a 2-meter balloon-borne telescope for far-infrared and submillimeter astronomy.
- » Will contain either a bolometer array camera or a heterodyne spectrometer at its focal plane.
- » Capable initially of 10 - 30 day flights (day and night operation) at 29 - 39 km altitude in a near space environment.
- » Eventually will become a 3-meter balloon-borne FIR/SUBMM telescope with 100 day flights.

- ADVANTAGES OF SOAR FOR FIR/SUBMM OBSERVATIONS

- » Low atmospheric absorption and background radiation.
- » High spectral resolution measurements without atmospheric interference.
- » Capable of long integration times on a given target.
- » Capable of mapping large areas.
- » Only a few percent of the cost of a space mission with comparable goals.

# INITIAL IMPLEMENTATION PLAN FOR SOAR



## TELESCOPE AND INSTRUMENTATION

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- TELESCOPE
  - » 2-meter diameter, f/1, primary mirror (single panel CFRP, 3  $\mu\text{m}$  rms surface accuracy), and f/13 Cassegrain telescope .
  - » Diffraction limited at 100  $\mu\text{m}$  wavelength (12.6 arcsec), FOV = 6.25 arcmin.
  - » Operating temperature: 230 K.
- BOLOMETER ARRAY CAMERA (MPIfR/Bonn)
  - » Simultaneous viewing in three broad bands (100, 200, and 300  $\mu\text{m}$ ; 30% BW).
  - » Diffraction-limited pixels at each wavelength.
  - » Total of 225 pixels.
  - » Bolometer temperature: 300 mK.
  - » Liquid He dewar with 30 day hold time.

# INITIAL IMPLEMENTATION PLAN FOR SOAR

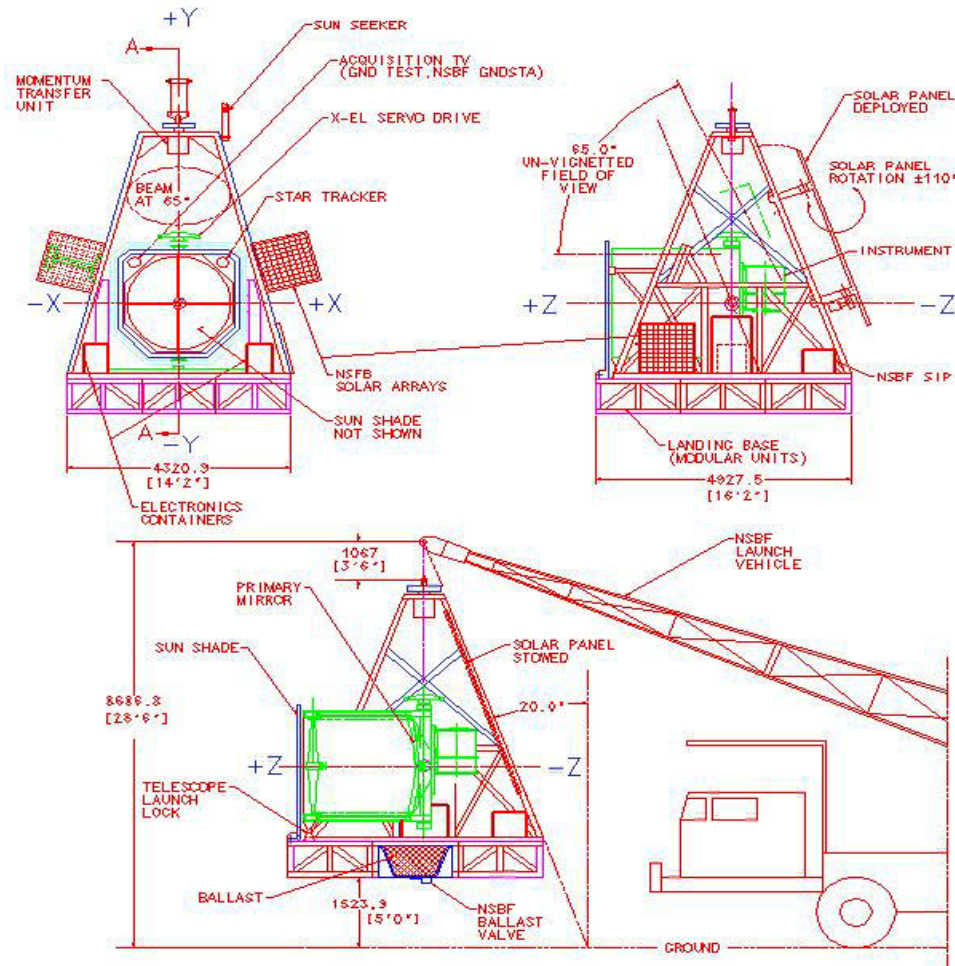


## GONDOLA

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- Pointing Control
  - » Three-axis gyro-stabilized telescope (azimuth, elevation, cross-elevation); raster scanning capability.
  - » 1 arcmin absolute pointing accuracy.
  - » 3 arcsec rms pointing stability.
  - » 1 arcsec pointing reconstruction
- Gondola
  - » Size: 6.0 m x 4.9 m x 5.2 m in dimension.
  - » Weight: 950 kg.
  - » Power: 560 W (solar cells and battery).
- Telemetry
  - » TDRSS: 4 kbit return continuous; on-board disk storage.
- Balloon
  - » 28 MCF Zero Pressure Balloon.
  - » 30 - 40 km altitude.

# SOAR EXPERIMENT DESIGN CONCEPT



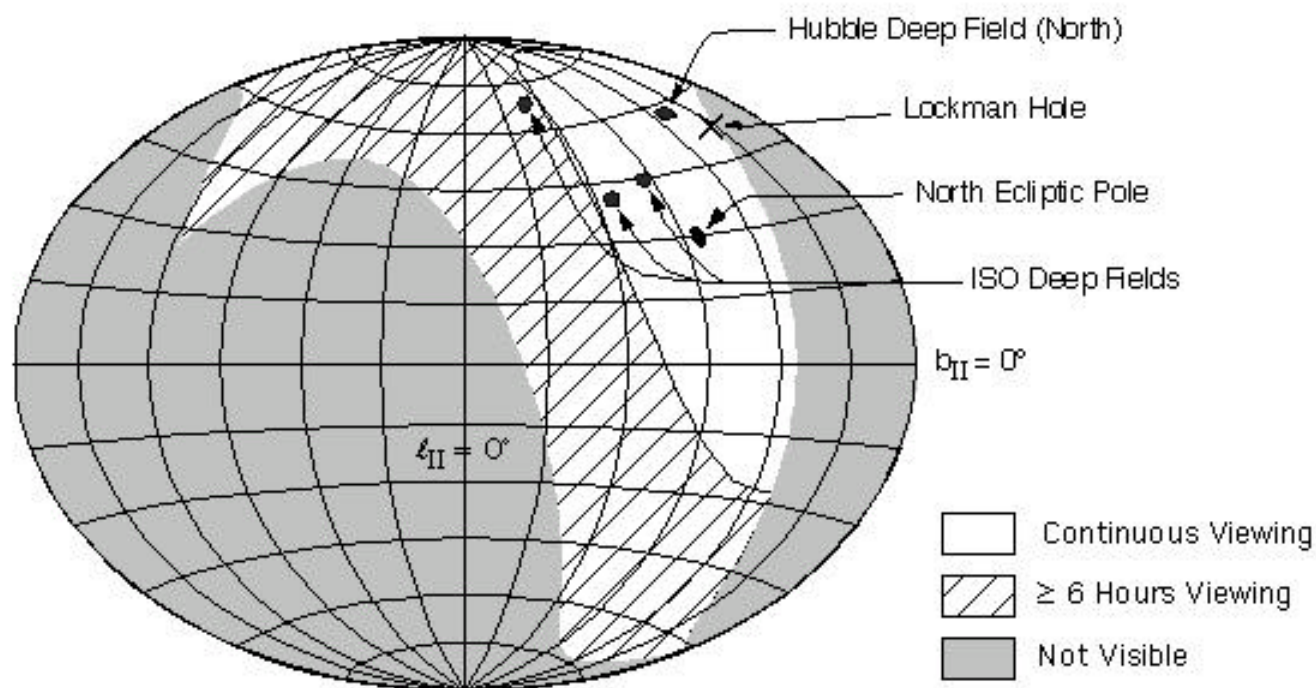
SECTION A-A

SOAR EXPERIMENT CONFIGURATION

# SOAR SKY VISIBILITY FOR FAIRBANKS, ALASKA LAUNCH

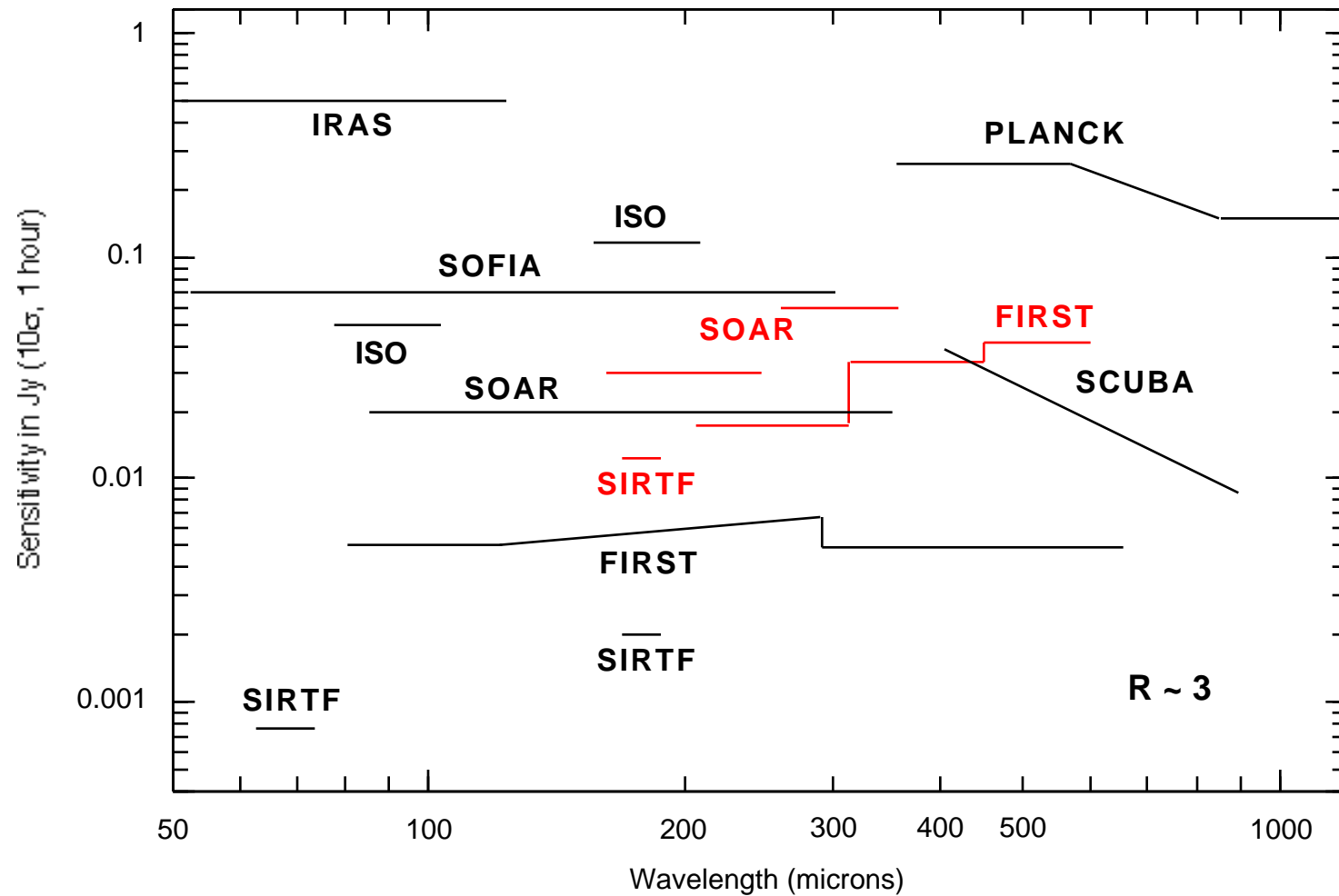


Daily Sky Visibility, in Galactic Coordinates, For a Fairbanks, Alaska, Launch (6/20)



# SOAR SENSITIVITY

## BOLOMETER CAMERA (10 $\sigma$ , 1 hr)



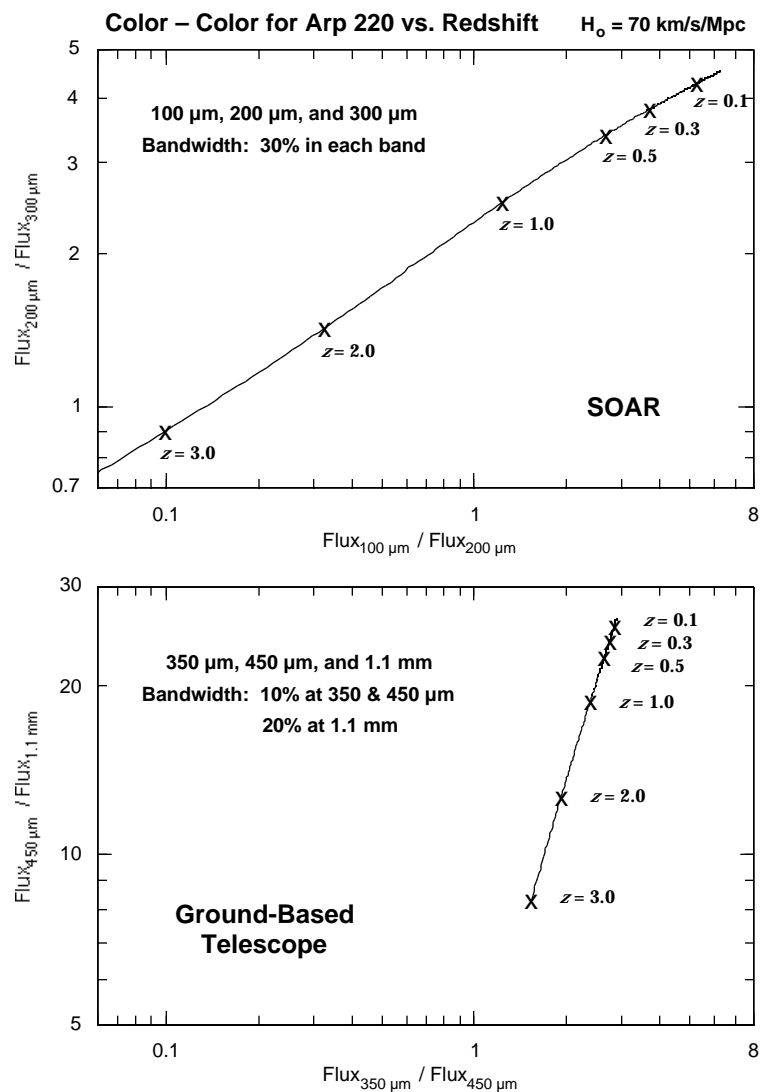
# INITIAL SOAR SCIENTIFIC OBJECTIVES



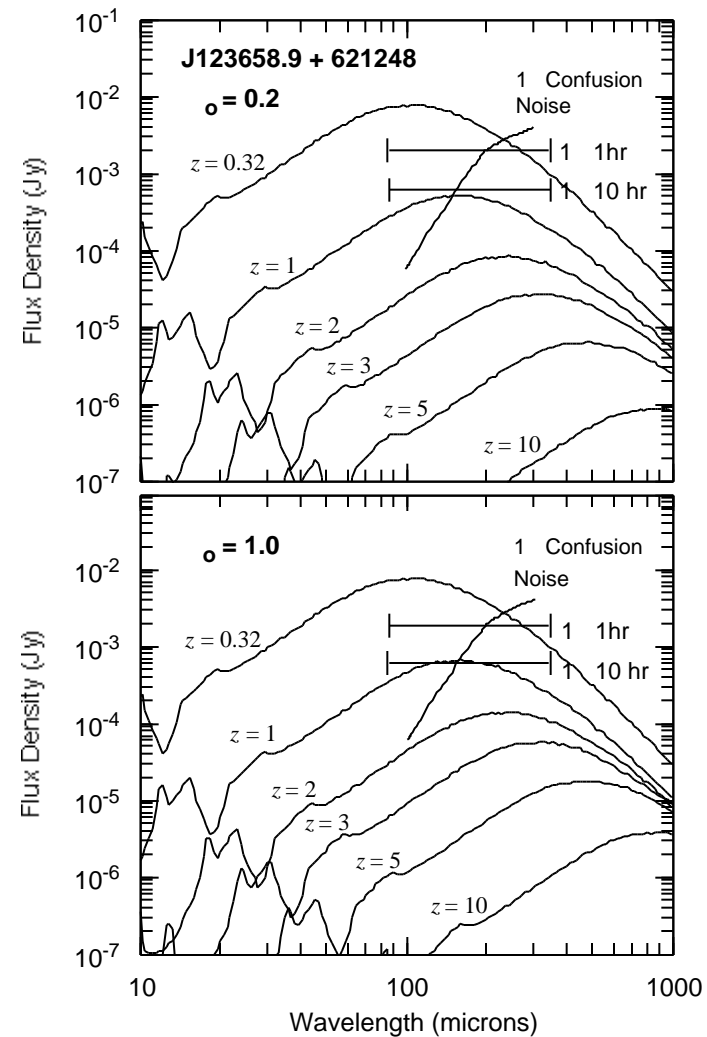
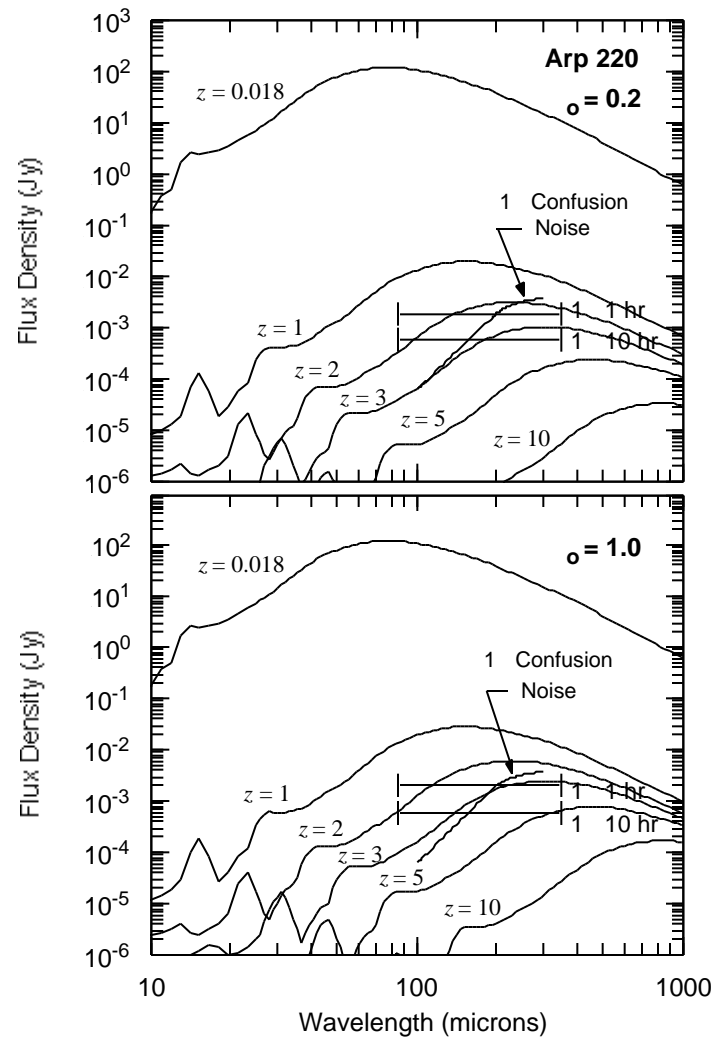
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- Formation and evolution of galaxies in the early universe
    - » Perform deep surveys to search for a population of protogalaxies whose redshifted dust emission peaks at FIR/SUBMM wavelengths.
    - » Determine redshifts photometrically.
    - » Determine the luminosity evolution as a function of redshift.
  
  - Evolution of protostars in Giant Molecular Clouds
    - » Perform large area, deep surveys of many molecular clouds to search for large range of protostellar masses.
    - » Detect cold protostars by dust continuum radiation at FIR/SUBMM wavelengths.
    - » Observe protostars at different stages of early evolution to study cloud fragmentation and core collapse.



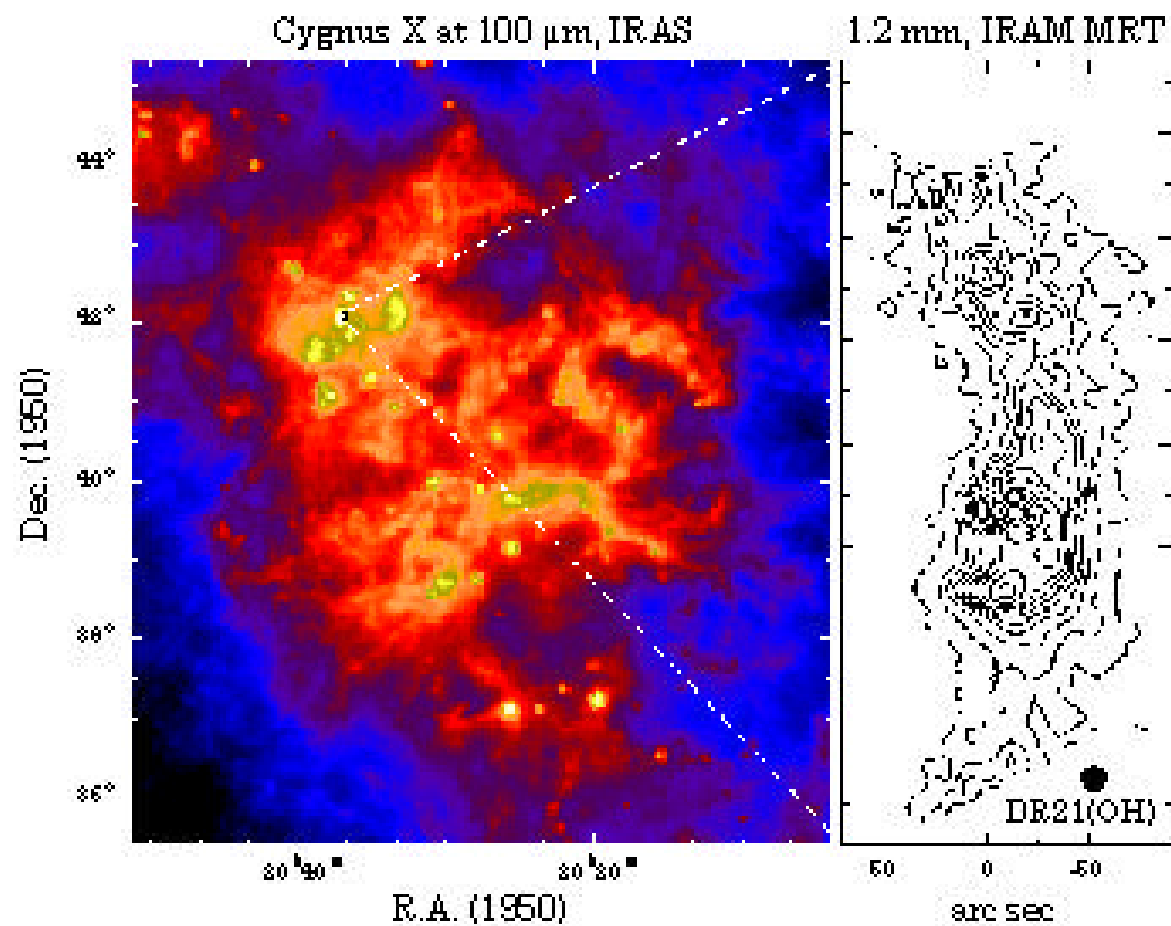
# COLOR-COLOR DIAGRAM FOR ARP 220 vs. REDSHIFT



# SPECTRAL ENERGY DISTRIBUTION ARP 220 AND ISO HDF GALAXY



# IRAS 100 $\mu$ m SURVEY IMAGE OF CYGNUS X REGION



## SUMMARY OF SOAR PROGRAM



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- Long Duration and Ultra-long Duration Balloon Program offers a means of conducting FIR/SUBMM science investigations otherwise obtainable only with very expensive (\$ > 400 M) space missions.
  - SOAR is technically ready now for construction as a LDB mission and eventually as a ULDB mission.
  - SOAR offers the best means:
    - » To study protogalaxies at FIR/SUBMM wavelengths until FIRST is launched late in the next decade.
    - » To perform large-area, high spatial resolution mapping of our Galaxy at FIR/SUBMM wavelengths.
  - Frequent flight opportunities will permit SOAR to always fly state of the art instrumentation.